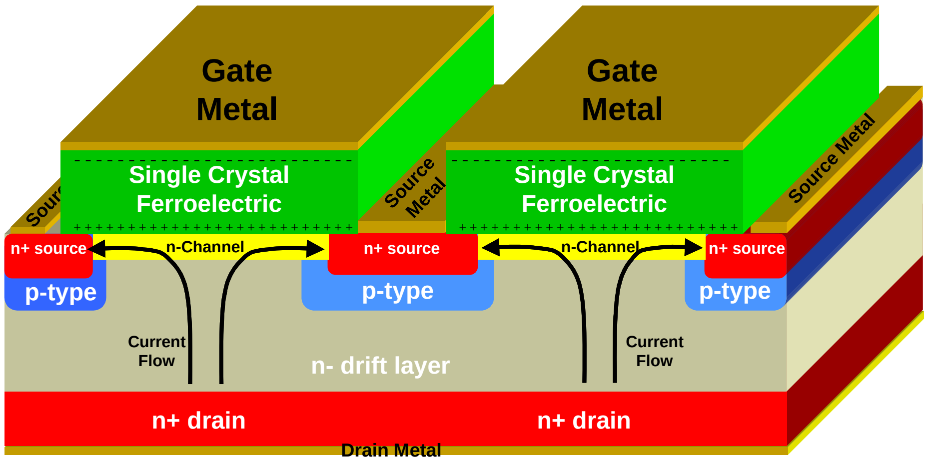
Ferroelectrically Switched SiC Power Transistor

Georgia Institute of Technology



W. Alan Doolittle, alan.doolittle@ece.gatech.edu

Goals & Objectives

•Increase current handling capability by decreasing the on-resistance of traditional MOS SiC switching devices by achieving material advances such as

- •Higher Charge density by factors of 10-100 compared to traditional SiC MOS technology
- •Improved effective channel mobility

•Provide transistors with static operation: Once switched off, the device stays off until turned back on

Main Technical Approach

Combine polarization discontinuity based device design and the extreme control of molecular beam epitaxy using novel growth chemistry to facilitate growth of patterned epitaxial lithium niobate on silicon carbide

Key Accomplishments

•1st ever: Demonstrated growth of SINGLE CRYSTAL lithium niobate on SiC using sputtering and novel chemistry MBE. This includes:

- •Commissioned and debugged MBE epitaxy system designed for lithium niobate
- •Modified and demonstrated commercial sputtering tools ability to grow lithium niobate
- •Demonstrated ability to pattern lithium niobate gates ICP

•Demonstrated functional crystalline lithium niobate MOS capacitors on SiC.

- •Drove a heavily doped substrate (~10^{19} cm^{-3}) into inversion
- •2.6:1 dielectric constant tunability with applied electric field

•Model results indicate transistor feasibility but also elude to fabrication challenges

Major Impact of Technology

When successful, the power handling capability of SiC based power devices should be improved by a factor of 100-1000. This will allow increased usage of all-electric drive capabilities in military vehicles.